

## **ABSTRACT**

This invention describes methods of synthesis and applications of planarized photonic crystals. Provided are simple, quick, reproducible and inexpensive methods that combine self-assembly and lithography to achieve the first examples of vectorial control of thickness, structure, area, topology, orientation and registry of colloidal crystals that have been patterned in substrates for use in lab-on-chip and photonic chip technologies. 1-, 2 and 3-D colloidal crystals patterned either on or within substrates can be used for templating inverted colloidal crystal replica patterns made of materials like silicon as well as building micron scale structural defects in such colloidal crystals. These photonic crystals can form the basis of a range of optical devices that may be integrated within photonic chips and coupled to optical fibers and/or waveguides to enable development of highly compact planarized optically integrated photonic crystal devices and circuits for use in future all-optical computers and optical telecommunication systems.